

MLS Instrument Concept

Mark A. Boyles

(Mark.A.Boyles@jpl.nasa.gov)

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Jet Propulsion Laboratory

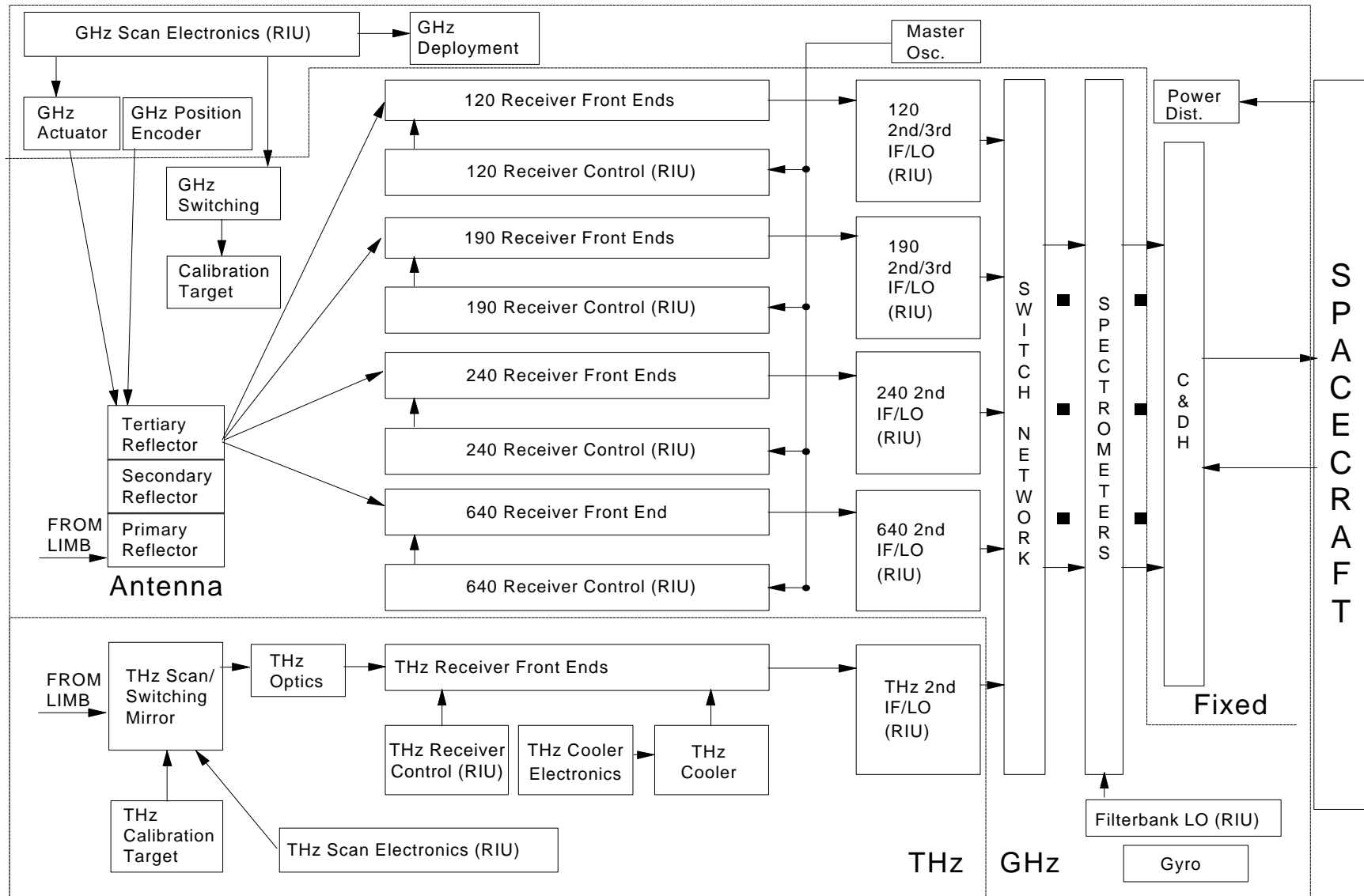
CHEM Cooperative Agreement Kickoff/Workshop System Description

- Three Modules: GHz, THz, and Fixed
 - GHz and THz modules are independent except for Switch Network and Filterbanks assemblies
 - These assemblies are shared and housed in the GHz module.
- GHz Module:
 - Cylindrically symmetric telescope optics for the GHz module with a parabolic torus primary, hyperbolic torus secondary and elliptical torus tertiary
 - Arrayed receivers ranging in frequency from 120 to 640 GHz with separate boresights
 - Receiver designs are based on MMIC technology for the 120 and 190 GHz receivers and planar technology for the 240 and 640 GHz receivers
- THz Module:
 - Design is based on a hot electron bolometer mixer, photomixerst LO and mechanical cooler
 - Contains its own scan mechanism and optics
- Fixed Module:
 - Houses common C&DH and Power Distribution Assemblies as well as some assemblies required for the GHz measurements.

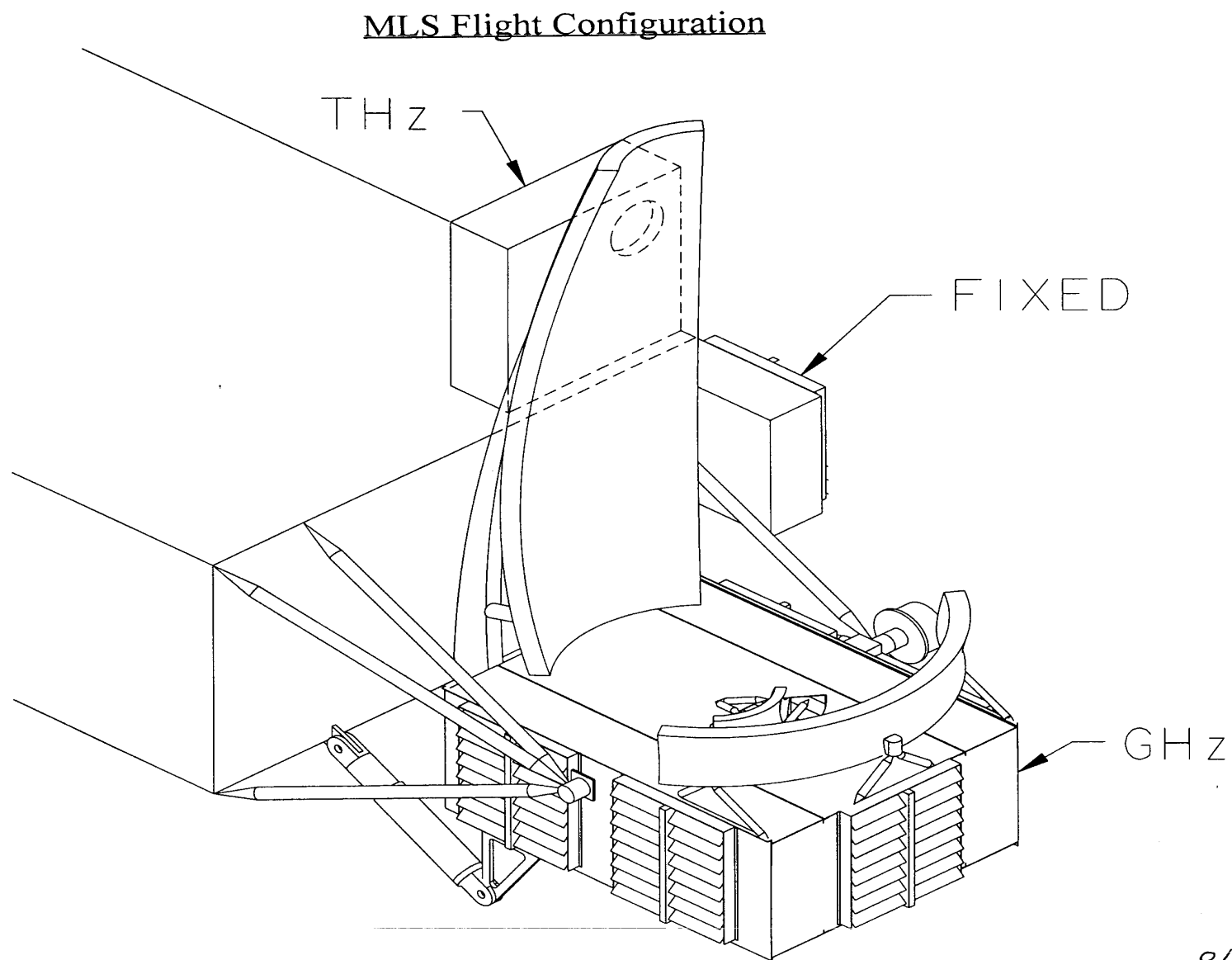
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System Description

MLS BLOCK DIAGRAM



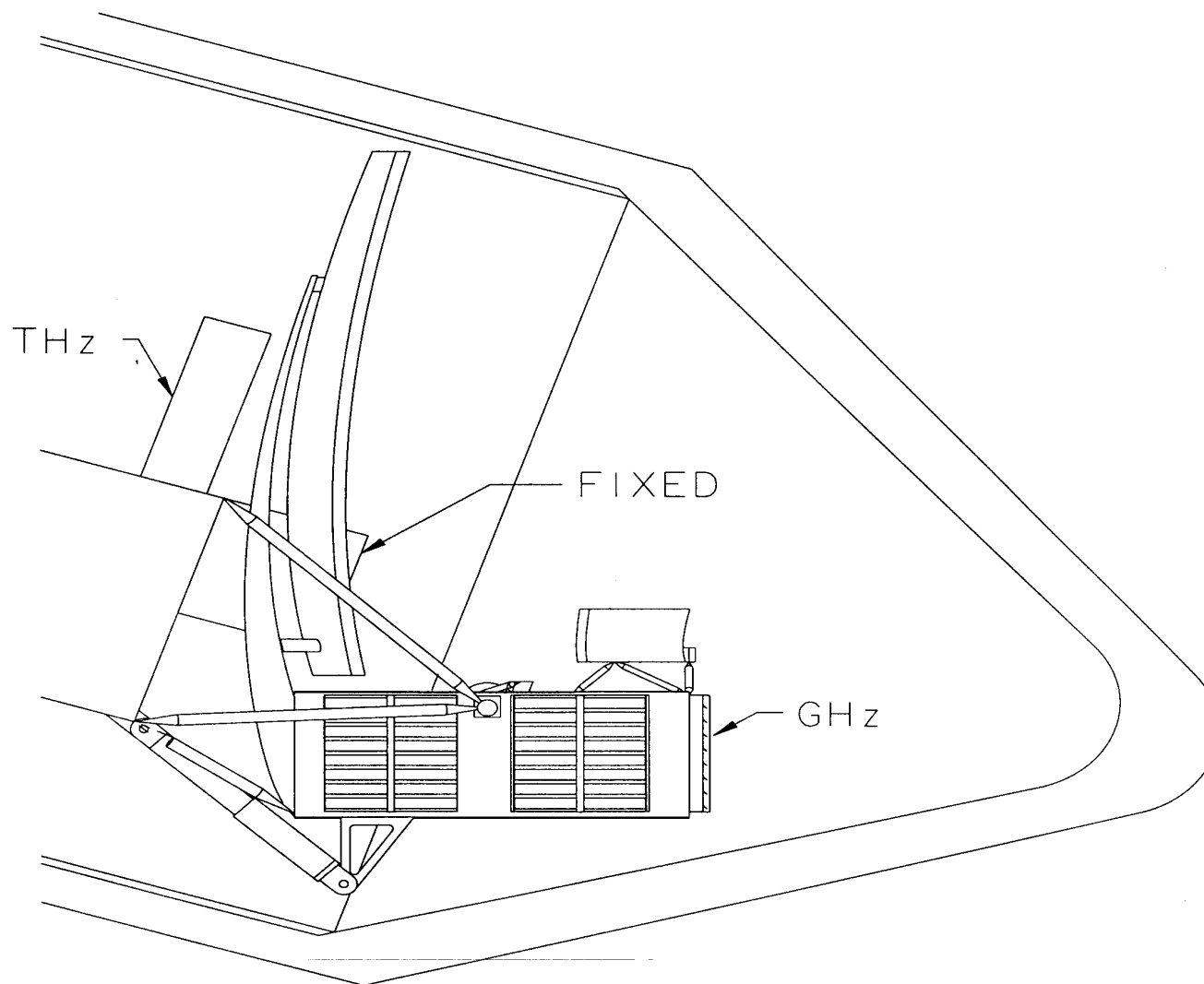
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MLS Launch Configuration



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System Resources

Resource	Current Best Estimate
Mass (kg)	
GHz	250
THz	50
Fixed	<u>45</u>
Total	345
Allocation (inc. 10% cont.)	330
Power (W)	
All 3 Modules	390 (Primary Operating Mode)
Allocation (inc. 10% cont.)	429
Envelope (m ³)	
GHz	1.5 x 1.7 x 2.5
THz	0.3 x 0.7 x 0.8
Fixed	0.5 x 0.2 x 0.5 (in GHz module envelope in current drawings)
Uncompressed Data Rate (kbps)	≤ 150

CHEM Cooperative Agreement Kickoff/Workshop Spacecraft Interfaces

- The instrument team is working to the General Interface Requirements Document (GIRD) for EOS Common Spacecraft/Instruments Revision A, January 1994, GSFC 422-11-12-01 including changes CH-01 & CH-02.
 - Currently comply with all GIRD requirements except:
 - Deviations proposed in the Draft version of the Unique Instrument Interface Document (UIID) for the Microwave Limb Sounder, September 1994, GSFC 424-28-24-02
 - Torque disturbances

Interface	Requirements
Mechanical	per GIRD; Kinematic mounts
Thermal	per GIRD; Isolated; Cold space FOV of TBD size required for all 3 modules
Electrical	per GIRD
Data	per GIRD
FOV (°)	
Along Track -- GHz and THz	60 to 72
Cross Track -- GHz	± 30 with negotiable offset
Cross Track -- THz	± 0.1

CHEM Cooperative Agreement Kickoff/Workshop Spacecraft Interfaces

- Unique MLS accommodation requirements:
 - Required at ground processing facility
 - High angular and temporal resolution gyro data
 - Temperature data for the spacecraft structure
 - Orientation of any device/object close to the MLS FOV
 - Quiet and pulse bus voltages
 - Solar position in S/C coordinates
 - Required at the instrument
 - Oblateness data with a resolution of ~0.5 km or better
 - Periodic marker (once per orbit)

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Special Considerations

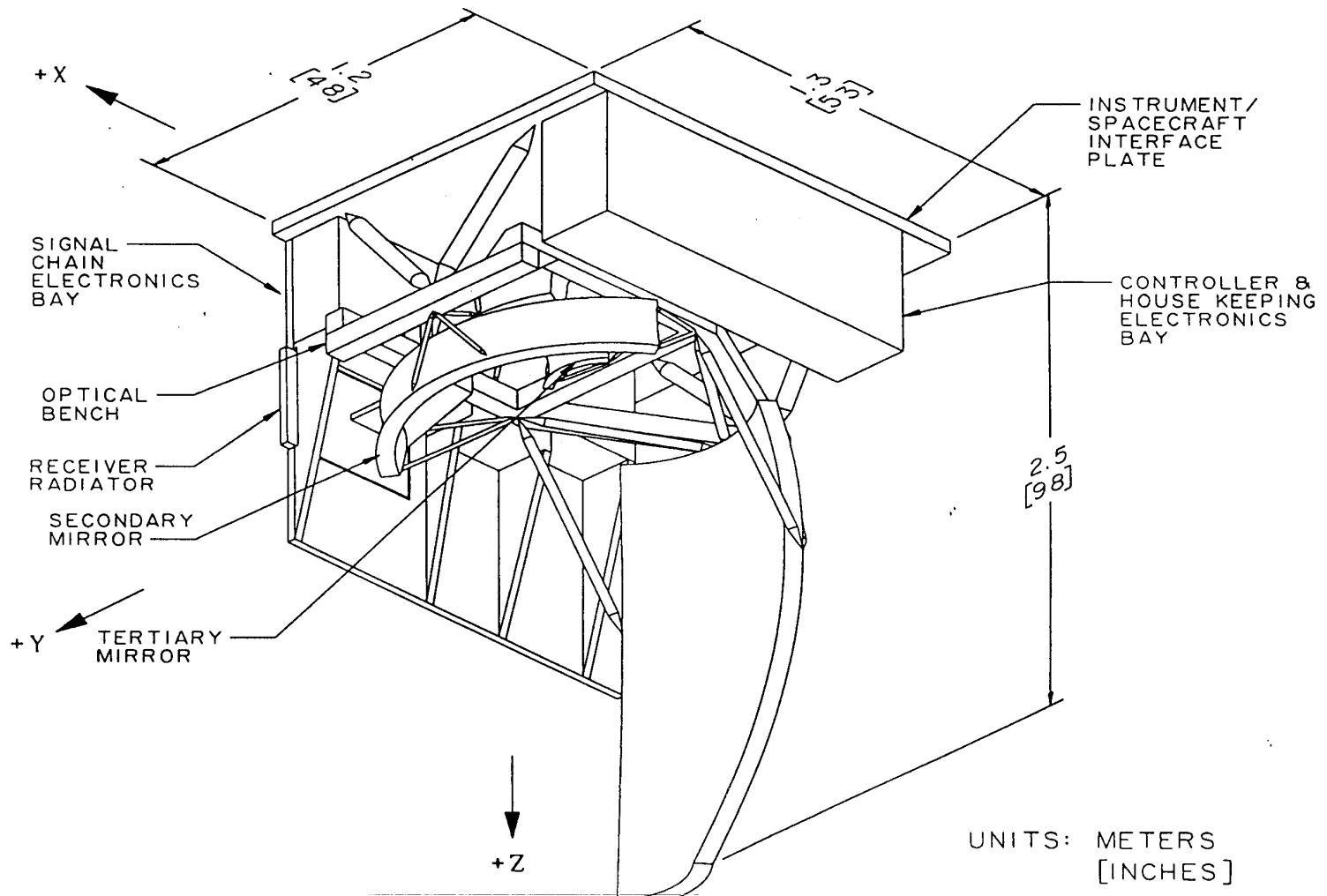
	Requirements
GHz Module Scan	Scan TBD kg; $\sim 1^\circ$ pk-pk; 14.2 s (TBR) one way, 2.5 s (TBR) for reversal and calibration target scan; repeated every 33.4 s; about center of mass
Calibration Target Scan	Scan 10 kg; $\leq 180^\circ$ pk-pk; 0.75 s (TBR) one way, 1 s (TBR) view period; repeated every 16.7 s
Instrument Deployment	TBD; Looking at schemes which deploy entire instrument with GHz Module actuator or which deploy primary mirror only
Pointing -- both Modules	
Control/Placement (arc sec)	180 roll, 1800 pitch/yaw
Jitter (arc sec/sec)	50 roll/pitch, 1800 yaw -- 0.1 to 30 s
Jitter Knowledge (arc sec/sec)	1 roll/pitch, 10 yaw (met by internal instrument gyro on common s/c)
2.5 THz/GHz Co-Alignment	1° yaw and roll

CHEM Cooperative Agreement Kickoff/Workshop Flexibility

- The MLS Instrument has flexibility in a number of areas.
- The design of the MLS Instrument can be optimized for different spacecraft:
 - Gyro, GHz Actuator, GHz Position Encoder and GHz Deployment Mechanism could be removed or modified
 - The envelopes of the different assemblies can vary
 - C&DH, thermal, power and structural interfaces could be changed
- Feedback from a spacecraft contractor would be welcomed.

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Example MLS GHz Module “Dedicated” Spacecraft Configuration



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CHEM Cooperative Agreement Kickoff/Workshop Backup Charts

GIRD Waivers Listed in the MLS UIID

- Optical Cube Surface:
 - Flatness - The surface shall be planar to within $\lambda/4$ rms, where λ is visible light.
 - Orthogonality - Knowledge of ± 1 arc sec
- Survival Heater Power:
 - The MLS survival power requirement is TBD% of the average instrument power.
- Connector Clearance:
 - Clearance provided around the outside of some of the mated connectors can be < 50 mm.
- Instrument Survival:
 - The MLS instrument shall withstand direct solar input into the primary reflector for 30 minutes without permanent degradation.

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GIRD Waivers Listed in the MLS UIID Continued

- **Harness Provider:**
 - Intra-instrument harness shall be provided by the Instrument Provider.
- **Command Sequence**
 - During ground testing and in-flight operation the application of power to MLS shall always be sequenced and executed in a prescribed order. i.e. All MLS electrical power loads shall not be powered by a single command. This waiver also applies when the spacecraft is recovering from an anomaly.
- **Minimum Fixed Base Frequency:**

Each separately mounted instrument component, configured for launch, shall have a fixed base frequency of \geq TBD Hz.

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Questions for TRW

1. Are there any limitations on the number of attachment points and their location?
2. Are there any limitations on the location of the instrument center of gravity?
3. Can we get a dynamic shroud and spacecraft launch configuration database?